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Citation for published version:

Chou, Y-S & Theodossopoulos, D 2014, Building Material Migration: Imported Brick Imported and Localization in Taiwan in 17th Century. in *The First Construction History Society Conference, Queen's College, Cambridge, 11-12 April 2014*. Cambridge, pp. 71-81.

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

The First Construction History Society Conference, Queen's College, Cambridge, 11-12 April 2014

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Title: Building Material Migration: Imported Brick and Localization in Taiwan in 17th Century

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Abstract:

In certain circumstances, the evolution of architecture is highly connected with construction technique development, which in turn may be generated by external cultures. This paper gives insight to such developments by discussing how brick was established as a new imported building material into Taiwan in the 17th century under Dutch influence.

Taiwan's architectural process started essentially by the Dutch from 1624, who built the first major permanent structures, three fortresses with associated burghs. Research into archives shows that the Dutch East India Company (VOC) brought for this purpose a new building material, brick, first by importing finished products from Southern China, then gradually moving to local production in Taiwan, which spread to several places within the island, even exporting to their strongholds in Japan. However, after the VOC left in 1662, the brick making industry supported by VOC seems to disappear in Taiwan as also the brick architecture.

Studies in this field have concentrated on the historic aspects of the presence of the VOC presence rather than their architecture. This study attempts for the first time a comprehensive dating of the key stages based on archive research. In addition, analysis of the masonry techniques of the scant remains frames the technology transfer process within the context of Dutch construction of the time.

Introduction: A material of force: bricks imported by the Dutch East India Company (1624-1662)

The Seventeenth Century for Taiwan was a crucial changing point in its history, from politics to architecture culture. Before that, Taiwan was an island with dozens of aboriginal tribes. Suddenly, Dutch, Spanish, Japanese, and Chinese came to the island for their own interests. Among them, Dutch traders took the lead and became the greatest foreign element for this island from 1624 to 1662. They also brought the new building technique, brick, and changed the architecture landscape of this island forever.

Before that point, the building materials in Taiwanese aborigines' housing were natural and local, such as timber, bamboo, grass, and stone plates. The brick which migrated to Taiwan is a result of a series of historic events, highly related to the trading wars of the period.

The Dutch East India Company (VOC) showed a strong interest to trade in East area in the beginning of the 17th Century, following the Portuguese and Spanish. In 1622, to open the trading business with China and Japan, twelve ships launched out from Batavia city (now Jakarta), VOC headquarter in Asia, to seek a trading base near China. After several fights, the target of trading base changed from Macau to Pescadores (Penghu Islands now), an archipelago between Mainland China and Taiwan, finally to their third choice, Tayouan (Anping area in Tainan City now) in Taiwan. In the following years, VOC established its power in this island. As the extension of its power network, the Dutch brought the brick in Taiwan, from importing the materials initially to local production, then spreading to different places in Taiwan. In this process, brick became a critical building material for VOC to establish reliable structures, in particular the three main forts (Fort Zeelandia, Fort Provintia, Fort San Domingo) that safeguarded their trade presence (Fig. 1).

For this background, Taiwan in the 17th Century is an excellent case to discuss the issue of foreign building material technique transfer in East Asia in Age of Exploration, driven by a Western superpower at that time (VOC). Discussion in this area is still quite few in present researches, thus, this paper intends to explore the migration of bricks, an advanced building material in Taiwan then, from importation to localization under VOC's influence, to understand the role of this particular building material in its historical context and how it was effected by political powers to sharp the local architecture landscape. This study attempts for

the first time a comprehensive dating of the key stages based on archive research. In addition, analysis of the masonry techniques of the scant remains that combines archive research and fieldwork frames the technology transfer process within the context of Dutch construction of the time.

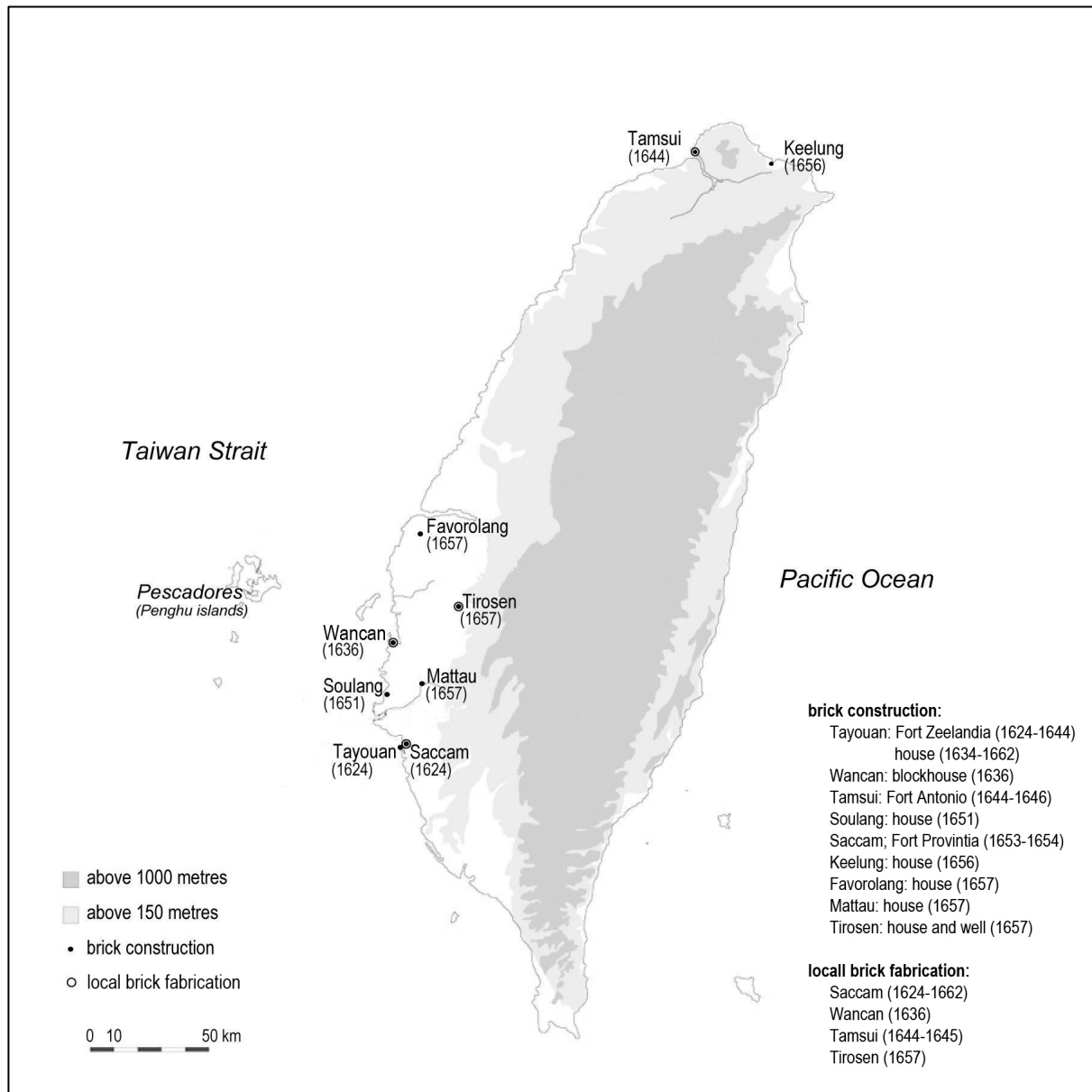


Figure 1. Brick construction and production in Taiwan in Dutch rule period (1624 - 1662)
(author's drawing)

More than Ballast - Brick through the VOC Network in Taiwan

The VOC created its empire by building its own network for trades, and brick was a significant part of it. Brick was commonly used as ballast of shipping in 17th and 18th Centuries [1]; however, for VOC in Taiwan in 17th Century, it was also a major building material that the company had a great demand for, not only for construction, in certain perspective, but also a kind of defence weapon of their trading system. Brick, the material itself and its fabrication process, was imported and spread as the VOC power was expanding in this island. This building material was imported to points of the network to strengthen the presence of VOC.

In order to understand the network of VOC in Taiwan, two collections of VOC archives are crucial: “*Letters of VOC-governor in Taiwan sent to Governor-General of Batavia*”, Volume I (1622-1626) and II (1626-1629), which includes 29 letters written by the VOC-governors in Taiwan to give a general report of Taiwan affairs to its headquarter in Batavia, about three to four letters in one year; “*Journal of Fort Zeelandia, Taiwan 1629-1662*”, which is the daily record by the VOC secretary in Taiwan for providing daily detail information of company activities. With these two archive collections, a network outline of brick use by VOC in Taiwan could be defined.

Brick became an indispensable building material for VOC for establishing permanent forts and company houses in Taiwan, so gathering bricks was one of the major works at the beginning of its business. On the one hand, the company imported bricks from its trading target trade - China; on the other hand, VOC introduced brick making techniques to produce them locally and depend less on China. Both sources of brick existed during the whole 38 years of Dutch rule period.

Start of imported and local production (1624-1635)

For the defence requirements, Fort Zeelandia in Tayouan is the first major project for VOC in Taiwan (Fig. 1). The building started in 1624 and the inner fort was finished in 1633. To get the trustable building material, the Dutch tried either importing for China or local production.

Importing bricks from China never stopped and it was a crucial working project in the first five years (1624-1629). Table 1 records the flow of bricks fabricated, imported or stored and

will be used to monitor the use of the material in critical periods. Less than half a year after VOC moved to Tayouan, 14,000 bricks were imported from China in December 1624 for Fort Zeelandia. [2] Although the local brick production appeared in the following year, imported bricks were still a crucial part for the company. In the archives, the Taiwan VOC-governor kept mentioning that bricks would continue being imported from Southeast China, in 1625, 1626, and 1629, to reinforce the wall of Fort Zeelandia and build the warehouses and company houses in Tayouan [3]. After that, imported bricks were less noted in the records. It could be considered that the China imported bricks have lost importance for the VOC officers because of the local production growing as discussed below.

Ensuring that brick production was local and sustainable was the one of the very first goals of VOC in Taiwan. [4] At the same time as importing the first batches of bricks, the VOC tried to import brick-making craftsmen from China in December 1624 and acquired 10 workers soon. However, the performance of the first crew did not satisfy the acting Taiwan VOC-governor, Martinus Sonck, because of the low production speed and may have replaced them with a Dutch sailor who could use the knowledge of brick-making quickly. [5] The demand for bricks for the VOC local authority was large and urgent, so they gathered bricks imported from China and producing them locally at the same time. As a result, the number of stored bricks increased quickly, from 14,000 in December 1624 to 111,000 total in October 1625 (Table 1). [6] In the following years, Siaccam area (changed its name to *Provintia* in the later period), a new town near Tayouan (Fig. 1), became crucial for local brick production. The local industry may have become strong enough for the VOC Taiwan demand in the 1630s. In 1634, VOC in Taiwan declared to collect a tithe – ten percent tax – on locally made bricks in Tayouan and Siaccam, including fired and unfired ones, to fund a brick company house; and forced all residents in Tayouan to rebuild their houses with bricks instead of common thatched cottage to prevent rebellions. [7] It also means the local production industry became mature certainly. Notes about brick from China are missing after 1630 in the archives, which means Taiwan VOC officers did not worry about the brick supporting problem as they did in 1624 and 1625, which gives an indication that the brick making industry had taken roots in Taiwan.

Table 1. Brick flow records in Taiwan (compiled by the author)

Date	Quantity	Origin	Destination	Project
05 Nov 1624	uncertain	China	Tayouan, Taiwan	Fort Zeelandia
12 Dec 1624	14,000	China	Tayouan, Taiwan	Fort Zeelandia
29 Oct 1625	110,000 (Partly imported)	China	Tayouan, Taiwan	Fort Zeelandia
14 Aug 1629	uncertain	China	Tayouan, Taiwan	Fort Zeelandia
18 May 1636 – 11 Jul 2016	uncertain (13 recordings)	Tayouan, Taiwan	Wancan, Taiwan	Blockhouse
15 Mar 1637	50,000	Tayouan, Taiwan	Firando, Japan	Office
01 Nov 1643	5,000	China	Tayouan, Taiwan	(no record)
10 Apr 1644	uncertain	Tayouan, Taiwan	Tamsui, Taiwan	Fort Anthonio
01 Jul 1644	10,000	China	Tayouan, Taiwan	(no record)
10 Jun 1645 – 16 Oct 1645	74,700 (total in 13 recordings)	China	Tayouan, Taiwan	(no record)
19 Mar 1646 – 16 Oct 1646	27,000 (total in 20 recordings)	China	Tayouan, Taiwan	(no record)
19 Mar 1646 – 16 Oct 1646	28,000 (total in 12 recordings)	China	Tayouan, Taiwan	(no record)

Transfer: from defence construction to houses (1636-1662)

After the brick making industry took root in Tayouan, VOC in Taiwan created a network of building material supporting system. Since 1636, apart from importing brick to the Tayouan area, VOC also exported bricks to their expanding controlling points in Taiwan. From the two sets of archives, VOC transported bricks internally to seven other areas in Taiwan in 38 years, from the material itself to fabrication techniques (Figure 1). This kind of transportation often includes defence concerns and strong military purposes for forts or blockhouses, such as Wancan in 1636 and Tamsui in 1644. Those two cases demonstrate VOC in Taiwan kept shipping bricks through its network and used that to strength the network, practical materials first, then the technique to produce and construct.

Wancan, the major producing point of ashes lime since 1624 [8], was also the first place of accepting transfer of local brick technique from Tayouan. In 1636, VOC in Taiwan decide to build a brick blockhouse there. For that purpose, Taiwan VOC-governor Hans Putmans went to Wancan in March 1636 to inspect if local production of brick was feasible. Once enough raw material was found, the project was decided to start on 14 April 1636. In the following

two months, bricks were shipped from Tayouan to Wancan, as appear in thirteen records, and the last shipping brick to Wancan is 11 July 1636. [9] There were other brick construction activities in this place later, but there is no record to ship bricks to Wancan ever. The blockhouse was finished in the following January. From these records, the first brick-making transportation inside Taiwan, fabrication in Wancan, might take two months to function well, so shipping physical brick records from Tayouan to Wancan only appeared in this period.

The second case, the experience of another fort built in Tamsui would provide more detailed information about the process. Following the steps of VOC, the Spanish built their short-lived colony in Tamsui area in northern Taiwan from 1626, but left in 1642 because they were defeated by VOC. After the Spanish left, VOC in Taiwan wanted to build a new fort there, Fort Antonio. The fort was established quickly with bamboos in 1642, and rebuilt with bricks between 1644 and 1646. [10] Because of great demand, VOC sent 50 brick-makers to Tamsui and even changed the production site once for better quality products. [11] Until May 1645, the storage of bricks in Tamsui increased dramatically in one year, reaching 300,000. [12] Considering the intense frequency of import records between 1644 and 1646 (see Table 1), it is possible that part of China imported bricks also were shipped to Tamsui to support the Fort Antonio project, but Tamsui locally produced bricks still played a great part of it.

The brick transfers by VOC in Taiwan before 1650 were based on defence concerns mainly. After 1651, the brick transfer activities extend to other constructions, such as house or wells. The brick company houses were built for local officers or priests. The first brick transfer record without strong defence concept is two company houses in Soulang in 1651, and the local priest and officer even argued who should take the better one. [13] Then brick company houses spread to other VOC selected places, such as Keelung, Favorolang, Mattau, and Tirozen (see Table 1 and Figure 1). Among them, Tirozen is a special case. VOC in Taiwan sent a Chinese craftsman there, who built a kiln to support the local production for a priest's house and a well in the central square in the village. [14] In this case, a Chinese brick-maker was transported under the network of VOC instead of the material - brick - itself.

Brick Export (1637)

Apart from exporting to different places within Taiwan island, Tayouan-made bricks were probably shipped to Firando (Hirado/ Nagasaki) in Japan. According to the record of 15 March 1637, VOC in Firando asked the company in Taiwan to send 50,000 bricks, no matter

whether made in China or Tayouan. [15] This record means that 13 years after 1624, the production of Taiwan locally made bricks was not only supporting the demand of VOC in Taiwan, but also enough to export. Moreover, it shows that bricks were the goods instead of ballast once again.

According to the archive study, the spread of brick and its fabrication technique, the production facilities (kilns) and the products (brick construction) appeared in several places in Taiwan. However, it is difficult to know what kind of techniques they applied exactly because of lacking relevant reference in archives and no kilns built in Dutch period survive in the present days, only few remains of brick construction. The study of bricks in the remains of Fort Zeelandia may indicate the different sources of brick, of imported and local production.

Bricks of remains of Fort Zeelandia

Very little of brick construction from the Dutch period in Taiwan is left today. Among them, the remains of Fort Zeelandia may be the best physical evidence. The brickwork shows the Dutch architecture knowledge of the period, and different brick sizes may indicate different production sources.



Figure 2 - Fort Zeelandia (about 1650), painted by Johannes Vingboon, commissioned by the VOC. (A collection of National Taiwan Museum) [16]

Fort Zeelandia is the first major project of VOC in Taiwan, and it is also the first brick building in Taiwan's architecture history in record in general. Construction started in 1624,

the interior fort finished in 1632, and the additional construction action may have lasted to the late of 1650s. It is a typical Dutch Fort of the 17th Century, that used to be consisting of three concentric layers of walls, including residences for the officials, churches, barracks, and jails (Fig. 2).

It is highly possible that the three layers construction of Fort Zeelandia was not planned from the beginning, but resulted as a response to the situations of different periods. Through archive research, the process of the construction could be put into four stages: timber wall, brick wall, external brick wall, and brick reinforcement (see Fig. 3). The first stage lasted only few months, between August and December 1624, when VOC built a shape of fort with timbers, for a temporary usage, as happens often when a new force arrives in a foreign land. In the meanwhile, Taiwan VOC-governor Martinus Sonck had planned generally to reinforce the construction with bricks and searched for the supply of this material. [17] The second stage lasted seven years, from 1625 to 1632, and scarps and bastions held with timber and clay were generally rebuilt with bricks, and the central fort with four bastions was all covered with brick wall in the end of 1632. [18] The third stage would end in 1643. In that time, the central fort added an outside layer with four roundels, and two bastions were added to of the external fort. [19] The final form was basically defined at this stage (see Fig 2, a drawing from 1650). Then at the fourth stage, the fort needed continuous repair because of the severe weather condition and the foundation problem, and the company reinforced it in late 1650s for preparing the war with Koxinga. [20]

The continued construction process caused a great demand of bricks. The number of brick used to build Fort Zeelandia is also a mystery. Considering the thickness of the wall mentioned in archives and the size of brick of the remains, the number of bricks used for the whole construction could be more than 5,000,000. [21] The number is enormous in quantity, considering the second layer of inner fort and the outer fort were built after 1632 but only few mentions of China imported bricks exist in archives, so it is also an indirect evidence to prove that local-made brick industry became the major supporter for the bricks of Fort Zeelandia construction after 1632.

Today, only fractions of the potent original establishment are left. (Fig. 3) Remains of Fort Zeelandia are in three parts: two parts of walls of outer fort, and part of roundel of outside walls of the inner fort. The condition of each part varies. The remains of the southern wall of

outer fort (Part B in Fig. 3 and left side of Fig. 4) are preserved in the finest condition of the whole ruins, about sixty five metres in length. Otherwise, the remains of the semi-circular bulwark of the inner fort (Right of Fig. 4) is worth more attention because of its thickness – about 2.2 m.

The composition of the remains reveals the attitude to Fort Zeelandia by VOC in Taiwan. Instead of earth or rubble in the middle core of the wall body, as happens often in walls of this size, VOC in Taiwan chose a hard and excessive way to build the wall – solid brick wall, up to 2.2 m. This is a noticeable feature since it is against the core of fort walls in the 17th Century sometimes had to be soft to absorb the impact of cannon balls in that period of gun powder. [22] It reflects the chronic insecurity of the VOC in Taiwan in that historical background, and proved that the brick was a reliable material for the Dutch then. The fact of brick wall rendered by ashes lime mortar emphasizes the function of this construction as an adjustment to the local weather – hot, rainy, and windy.

The Dutch used a simple but functional brickwork bond to build this fort. From study of the remains, each layer use headers as the major elements of wall body, and a row of stretchers would be put on one side of wall face. The brickwork pattern of the upper layer is reversed and horizontally shifts the distance of half brick (Fig. 5 & Fig. 6). This maximizes the strength of joints, suitable for defence function. The level of each layer preserves well that certain brickwork knowledge and craftsman is required, which could be clearly seen from the remains of the semi-circular bulwark of the inner fort. The average thickness of joints of layers is about 15 to 20 mm.

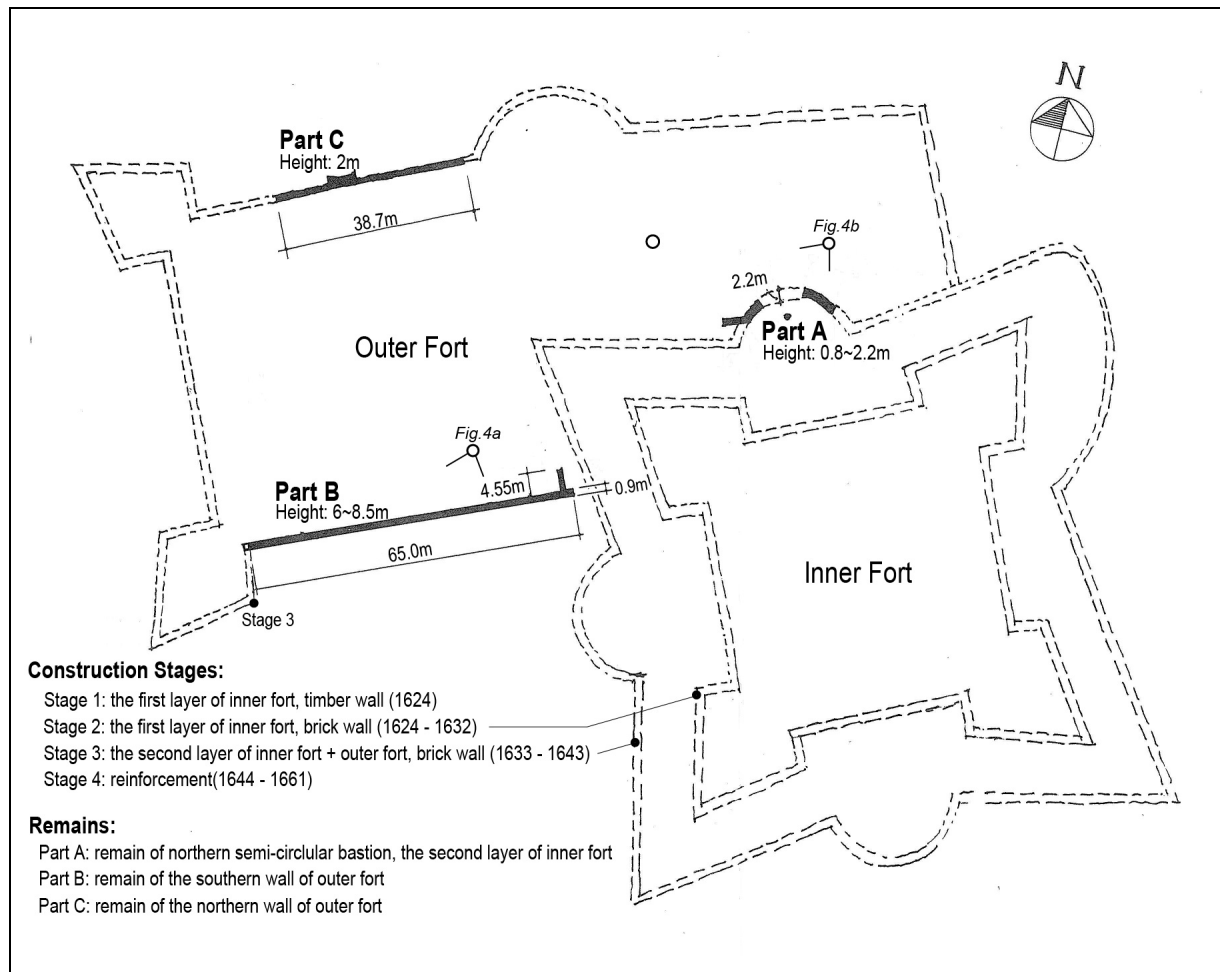


Figure 3. Map of construction stages and remains of Fort Zeelandia (Author's drawing.

Background diagram: [23])



Figure 4 – A) north elevation remains of southern wall of outer fort; B) remains of the semi-circular bulwark of the inner fort (author's photos, 2011)

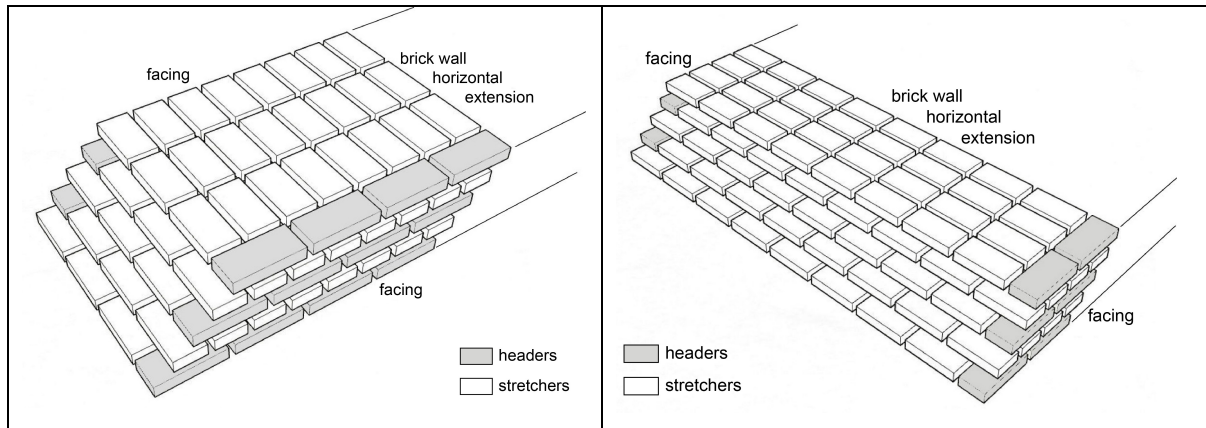


Figure 5. Two brickwork patterns of remains: A) southern wall of outer fort; B) semi-circular bulwark of inner fort. (author's drawings)

In general, the colour of the bricks of Fort Zeelandia is orange red, and the texture of its appearance is slightly rough, without glazed texture. From some surface frayed brick, it could be said the brick may have been fired for dozens of days (Fig. 6). Size of bricks varies, there are two types in thickness in general: One is longer and thinner, about 230 mm long, 115mm wide, and 35mm thick (Fig. 6a); the other is compact and thicker, about 210 mm long, 100mm wide, and 45mm thick (Fig. 6b). Considering brick size could change by 5%~10% during firing, the major difference of these two bricks is thickness. The remains of the semi-circular bulwark of inner fort were built with the former one. But the remains of southern wall of inner fort are much complicated, mixing these two types (see Fig. 7). The best example is its north side that shows clearly the two different types used, the facing one (45mm) being the thicker and the inner one (35mm) being the thinner.

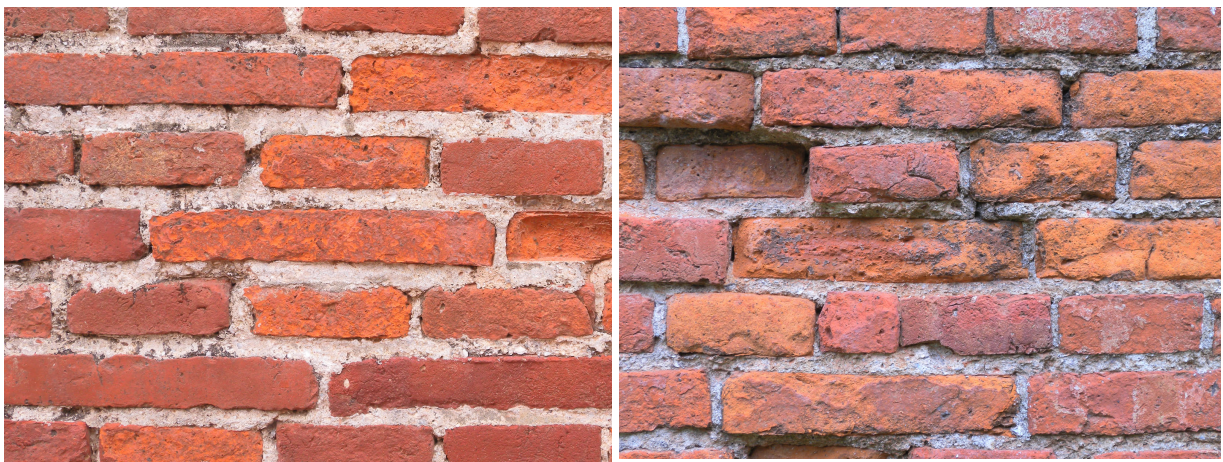


Figure 6. Two sizes of bricks on the north elevation remains of the southern wall of outer fort: A) 230*115*35mm; B) 210*100*45mm. (author's photo, 2011)



Figure 7. Mixed sizes of bricks, north (inner) elevation, southern remains of outer fort. (Part B in Fig. 3): thicker types facing a thinner-type inner core (author's photo, 2011)

The explanation for the two sizes of bricks is still a puzzle. One possibility is that it may represent the different sources. Comparing with common historical brick sizes in Fujian of China [24] and Amsterdam [25], the size of thinner one (230*115*35mm) is relatively close to Amsterdam; in addition, this proportion is rare in Fujian. Therefore, this type may be local fabricated under VOC's supervision; some of them may even from Batavia even Amsterdam as ballast. Alternatively, the thicker one (210*100*45mm) could be imported from China; however, the similar brick size also appeared in Amsterdam nearby area [26]. The exact sources of these two bricks still need more archaeological research to confirm.

CONCLUSIONS

The research gave an outline of brick imported and localized in Taiwan under Dutch in the 17th Century. Unlike the company common habits, transferring the physical bricks as ballast, VOC in Taiwan actually made this technique localization. However, the technique of manufacture may not come from the Dutch. To acquire this reliable and familiar building material in East Asia, they decided to import the end products from China, and using Han Chinese craftsmen for local fabrication at the same time. With archive and fieldwork research, these two methods to obtain bricks were always existed during the whole Dutch period. As a reliable building material for VOC, the transfer included end products or fabrication skill, and building material and technique spread highly depended on support of authority - VOC.

Some further research is needed to understand the process in more detail. For instance, further archaeology research may help to define the source of different sizes of bricks; the brick making technique, repairs and design changes to support the discussion of the evolution etc.

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